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EG&G ROCKY FLATS

EG&G ROCKY FLATS, INC.
ROCKY FLATS PLANT, P.O. BOX 464, GOLDEN, COLORADO 80402-0464 • (303) 966-7000

September 2, 1994 — 94-RF-08904

F. R. Lockhart
Environmental Restoration Division
DOE, RFFO

MINIMAL TREATMENT FOR POND SLUDGE - SRK-185-94

Action: None required

This letter and its attachment describe the Operable Unit (OU) 4 (Solar Ponds) sludge treatment process under development by EG&G and document your concurrence with this path during our meeting on August 31, 1994. The process will provide minimal treatment of the sludge. We have also described alternate treatment options and why they were rejected. Halliburton-NUS (HNUS) and their subcontractor, Brown and Root Environmental, are performing the conceptual design for the minimal-treatment process.

EG&G has, with input from Rocky Flats Field Office (RFFO) staff, selected a treatment that meets the threshold and primary Comprehensive Environmental Response Compensation and Liability Act (CERCLA) National Contingency Plan (NCP) criteria. These NCP criteria are: protection of human health and environment and "applicable" or "relevant and appropriate" (ARARs) compliance; and long term effectiveness, treatment, short term effectiveness, and implementability. Success in meeting these criteria will be evaluated on a technical and regulatory basis prior to submitting the proposal in the OU 4 Phase I IM/IRA Decision Document. We believe that the minimal-treatment process meet these NCP criteria. Our bias for action compels us to proceed with planning and implementation of the selected design.

There are also two modifying criteria in the NCP. Success in meeting the modifying criteria of State and public acceptance is difficult to predict. If State or public acceptance of minimal treatment fails, schedule impacts would be inevitable. The impacts could cause us to miss subsequent Interagency Agreement (IAG) milestones and lose predicted cost savings associated with including sludge in the OU-4 remedy.

The selected treatment description and alternatives analysis are attached. Also attached is the first subcontractor minimal treatment design deliverable: The White Paper. We have discussed the OU 4 remedy, including sludge treatment with your staff. All parties share an understanding of the risks and benefits available in the chosen approach.

We are proceeding with the minimal treatment process design. The IAG commitment dates we will propose to RFFO in September will reflect our assumption that the proposed treatment, as well as the balance of the proposed remedy, will meet with regulator and public acceptance. While we will include a prudent schedule reserve, that schedule reserve would not be expected to cover political failure of our technical preference. A draft concurrence letter is attached for your convenience.

ADMIN RECORD
IA-A-000300

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If you would like to discuss this further, please contact Andy Ledford, extension 8673, or Joe Mellen, extension 8607.

S R Keith

S. R. Keith
Program Manager
Solar Pond Projects
EG&G Rocky Flats, Inc.

KCL:jlb

Attachments:
As Stated

Orig. and 1 cc - F. R. Lockhart

cc:

S. Howard	-	DOE, RFFO
M. Witherill	-	DOE, RFFO

I. CRITERIA FOR TREATMENT PROCESS:

Process Criterion for Treatment

- The treatment proposed shall be the minimum treatment needed to meet performance criteria established for the closure.
- Land Disposal restrictions do not apply to the treatment product.

Performance Criteria for Treated Waste Form

a) The waste form shall not, prior to placement, contain free liquids. Demonstration of lack of free liquids shall be accomplished with the Paint Filter Test.

b) The waste form shall not be monolithic. All waste form particles shall pass a 3 inch mesh screen.

c) The waste form particles shall not agglomerate during storage after production such that particles larger than allowed in b) above are formed, unless such oversized particles can be reduced in size to meet the requirement in b) with normal application of hand tools or through the soil blending process.

d) The waste form as received shall be capable of mixing with the site soils such that no agglomerates larger than those allowed in b) are formed.

e) The waste form shall be maximally resistant to dispersion by wind. Dispersion resistance can be accomplished through control of moisture content of the as-delivered form, through control of the particle size of the form, or through other acceptable control of other intrinsic waste form characteristics.

f) The waste form shall be such that delivery of the form to the remediation site is accomplished "just in time" so that storage of the waste on site is minimized.

g) The waste form shall contain no additional materials that, either because of quantity or character of the materials or both, cause existing assessment of modeling of health effect, contaminant migration, or ground water protectiveness to become invalid and that cause the currently proposed remedy to fail to adequately protect human health and the environment.

h) The waste form shall be treated or prepared such that pathogens are removed or rendered innocuous to the extent that workers exposed to the material, and not wearing protective equipment, will be protected from effects of such pathogens.

i) The waste form shall be treated or prepared such that gas production from the form, in type, rate, and volume, shall be no greater than such production from an equivalent volume of natural soil from the site.

II. SLUDGE TO BE TREATED

The pond sludge consists of all waste removed from Ponds 207 A, 207 B series, 207 C, and the Unit 48 Clarifier. The sludge will be transferred to the 750 Pad storage tanks. Minor amounts of pond contents, mostly rocks, will be stored in crates. Excess water will be decanted from the sludge only as operationally convenient to ensure adequate storage space in the tanks on-hand. The existing characterization data, as modified to reflect the tank storage configuration, will be used to describe the sludge. Some sludges may be co-mingled as a function of storage decisions.

III. SELECTED TREATMENT PROCESS

Ex-Situ mixing of sludge with OU 4 soils: Pond sludge, including the solids and water, will be retrieved from the 750 Pad storage tanks and blended with lime, flyash, and soil excavated from the OU 4 impoundments and surrounding areas.

Minor amounts of pond contents stored in crates contain particles that exceed the size/agglomeration criteria. This material will be treated, if necessary, to meet all other performance criteria and physically processed at the construction site in the same manner as soil material that exceeds the size/agglomeration criteria.

Benefits: Cheap; easily designed, fabricated, installed and operated.

Quick; allows for processing sooner
Acceptable; will be in compliance at the Point of Delivery.

Disadvantages: Public Perception: Untreated, sludge and water is going back into the ground
Precedent setting: we will be first with CAMU, and will pioneer (again) regulators interpretations/applications of T. U.

IV. REJECTED ALTERNATIVE TREATMENT PROCESSES

a) Pondcrete pellets: The existing-design HNUS pondcrete process will be modified to produce 1 inch pellets rather than monoliths.

Benefits: Treatment of sludge and water to LDR's completed, existing equipment design could be used with modification, some existing equipment is available as GFE.

Chemically stabilizes the waste. A true chemical stabilization and solidification (CSS).

Disadvantages: Highest cost; labor intensive; process control system is the most complex.

Expensive; time consuming; new technology (Pelletizing) to be added to existing design.

Fails the Process Criterion for minimal treatment, in that the pondcrete process was designed to produce LDR-compliant waste.

b) In-situ sludge and soil mixing: Transport the liquid sludge to the construction site and incorporate the liquid directly into the lifts of contaminated materials (with, for example, a roto-tiller) after the lift material is spread but before compaction.

Benefits: Most simple process
Least estimated cost
Produces least volume increase in burial cell
Easy, quick

Disadvantages: Fugitive emissions are a concern
State and Public acceptance expected to be low
Control of free liquids
Transportation risk of liquid spill
Additional unknown QA/QC complexities "ensuring" the process meets performance criteria

c) Dewatering sludge - place "filter cake" in closure, mix with soil

Benefits: Filtration study completed for A/B sludge

Disadvantages: No filtration study completed for C Pond materials
Filtration unit estimate high cost, long lead time
Estimate will dispose of only 30% of sludge volume
Filtrate would contain 30-40% dissolved solids; would choke Building 374 for several years produce approximately 4,000 1/2 crates of saltcrete for disposal. Only very limited design work done.

d) Mix sludge with soils only

Benefits: Readily available, estimate relative low cost
Relatively simple process
Could meet some of the WAC/PS

Disadvantages: Expect State and public acceptance to be low
Cost savings over selected process appear minimal

Attachment 2
94-RF-08904

ROCKY FLATS
SOLAR POND PROJECTS
ACCELERATED SLUDGE PROCESSING CONCEPTUAL DESIGN

WHITE PAPER

Prepared For:

EG&G ROCKY FLATS, INC.
Golden, Colorado

Prepared By:

HALLIBURTON NUS CORPORATION

August 24, 1994

SUBMITTED BY:

Richard Ninesteel

RICHARD NINESTEEL, P.E.
PROJECT MANAGER

APPROVED BY:

D R Brenneman

DONALD R. BRENNEMAN
VICE PRESIDENT
CORPORATE SPONSOR

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EXECUTIVE SUMMARY

Halliburton NUS was contracted by EG&G Rocky Flats to generate a conceptual design to minimally treat sludges from the 207 Solar Evaporation Ponds and 788 Clarifier (presently in storage tanks) to an acceptable standard to allow placement under the Operable Unit 4 cap. The Waste Acceptance Criteria (WAC) required that the treated waste have no free liquids; contain no pathogenic or gas-producing micro-organisms; have no particles larger than 3 inches; and be compacted to 90% Proctor density.

The treatment system conceptually designed to satisfy these requirements is composed of the following operations:

- Transfer of the sludges from the storage tanks to the treatment mixing/blending process.
- Transport and staging of contaminated soil to the treatment mixing/blending process.
- Storage and transfer of additive(s) to the mixing/blending process.
- Mixing/blending the sludge, soil and additive(s) and discharging to a staging area.
- Transfer treated waste to the OU-4 closure area.

The primary additive used in the treatment process is lime, which is not only a proven biocide, but is also effective in controlling moisture content. The project schedule estimates that the treatment system will be operated for six months; an additional three month schedule reserve is provided. It is estimated that the treatment system will have the following estimated costs: capital ($3,000,000), operations and maintenance ($2,900,000), and decontamination and dismantling ($110,000).

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1.0 INTRODUCTION

This White Paper has been generated by Halliburton NUS (HNUS) to satisfy the requirements of the Statement of Work (SOW) presented by reference in the EG&G Rocky Flats Letter Task Order No. 225471001ST3. The SOW specified that a conceptual design be developed to minimally treat sludges from the five 207 Solar Evaporation Ponds and 788 Clarifier (presently in storage tanks) to an acceptable standard to allow placement under the Operable Unit 4 cap. The SOW stipulated that the conceptual design be developed in two discrete deliverables, a White Paper and a Conceptual Design Report.

The White Paper, which was to be generated first, is to provide a general description and design basis for a system which would treat the sludges to the waste acceptance criteria (WAC) presented to HNUS by EG&G Rocky Flats on August 10, 1994. The White Paper would then be used as input to the Operable Unit 4 Interim Measures/Interim Remedial Action Decision Document (by others) and as a basis for the development of the Conceptual Design Report. The information provided in this document is considered to be preliminary, pending the results of the pond sludge treatability study.

2.0 BACKGROUND

2.1 HISTORICAL PERSPECTIVE

Operable Unit Four (OU-4), the Solar Ponds, is an element of the United States Department of Energy's (USDOE) Environmental Restoration Program at the Rocky Flats Plant. OU-4 includes five solar evaporation ponds: 207A, 207B series (north, center and south), and 207C. Starting in the late 1950s the ponds were used to store and evaporate low-level radioactive process water.

The sludges have been removed from the five Solar Evaporation Ponds [207A, 207B series (north, center, and south), and 207C] and the Building 788 Clarifier and are being stored on an interim basis in 66 tanks on the 750 Pad. Each of the interim storage tanks has a nominal 10,000-gallon capacity.

Wastes from the Solar Evaporation Ponds 207A and 207B are a combination of liquid and solids, and the total stored volume is approximately 220,000 gallons. Wastes from Solar Evaporation Pond 207C are a combination of liquids, sludge, and salts, and the total volume stored is approximately 413,000 gallons. Wastes from the 788 Clarifier are predominantly sludge, and the total volume stored is approximately 27,000 gallons. The hazardous waste codes associated with the wastes from the ponds and clarifier are: F001, F002, F003, F005, F006, F007, F009 and D006.

As part of the closure plans for OU-4, the stored sludges are to be treated to satisfy specific waste acceptance criteria (WAC) and then placed in the OU-4 closure area and covered with a cap.

2.2 REGULATORY FRAMEWORK

The Rocky Flats Plant has multiple units regulated under the Resource Conservation and Recovery Act of 1976 (RCRA). The Solar Evaporation Ponds (207A, 207B, 207C) are interim status RCRA units. Paragraph 3008(h) of RCRA requires corrective action for all releases of hazardous wastes or constituents from solid waste management units at hazardous waste treatment, storage or disposal facilities.

The Rocky Flats Plant is also listed on the National Priorities List (NPL). The NPL is the list of sites that represent a potential threat to human health or the environment which was created and is periodically updated by the United States Environmental Protection Agency (USEPA) pursuant to Section 105 of the Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA). Section 120 of CERCLA requires remedies for Federal facilities sites on the NPL. Accordingly, the Rocky Flats Plant is subject to regulation under both RCRA and CERCLA.

An Interagency Agreement (IAG), signed by the USDOE, USEPA Region VIII, and the Colorado Department of Public Health and Environment (CDPHE) on January 22, 1991, includes provisions for the remediation of contaminated sites at the Rocky Flats Plant under both RCRA and CERCLA. The IAG identifies sixteen Operable Units (OUs) ranked in order of decreasing risk to human health and the environment. The Solar Evaporation Ponds (207A, 207B, 207C), and Clarifier 788 are part of OU-4, indicating that the closure of these areas is a high priority. These impoundments within OU-4 have been designated as Individual Hazardous Substance Site (IHSS) 101.

The IAG also provides a process for the creation of an Interim Measure/Interim Remedial Action (IM/IRA) Decision Document (DD). An IM/IRA DD for closing the ponds was drafted in May 1994 for review by the regulatory community. The IM/IRA DD serves as the permitting mechanism for the facility. This White Paper, and the Conceptual Design Report (CDR) which is to follow, are to be folded into the IM/IRA DD. Upon finalizing the IM/IRA DD, the USDOE will submit a modification to the Part B Permit Application for Management of Hazardous Wastes that will reflect the contents of the IM/IRA DD.

The IAG requires the closure of OU-4 in two phases: Phase 1, which focuses on source control (characterization, removal and proper disposal of Solar Pond sludges, and contaminated soils as well as closure of the Solar Ponds), and Phase 2 which addresses groundwater contamination and other concerns of the regulators. Accordingly, the preparation of this White Paper is one of the tasks to be performed within Phase 1.

The White Paper and CDR are to serve as input to a Draft IM/IRA DD, which is to be submitted to USEPA Region VIII and the CDPHE. Following a regulatory review period the DD will be modified to reflect the contributions of the regulators. At this point the USDOE is proposing to issue a proposed IM/IRA DD for public comment on January 26, 1995, a final IM/IRA DD on July 24, 1995, and to begin remediation on September 27, 1995.

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3.0 DESIGN CONSIDERATIONS

3.1 WASTE ACCEPTANCE CRITERIA (WAC)

The waste acceptance criteria (WAC) which the treated waste must satisfy before it can be placed in the OU-4 closure area were presented to HNUS by EG&G Rocky Flats on August 10, 1994. The provisions in the WAC that specifically impact design considerations for the solar pond sludge treatment system include:

- The treated waste shall have no free liquids as verified by the Paint Filter Liquid Test (SW 9095).
- All particles in the treated waste shall pass through a 3-inch mesh screen.
- The treated waste shall be resistant to wind dispersion.
- Storage of the treated waste at the OU-4 closure area shall be minimized.
- Pathogens, if present, shall be rendered innocuous.
- Gas production shall be no greater than that generated by natural site soil.
- The treated waste can be compacted to 90% Proctor density.

3.2 DESIGN ASSUMPTIONS

As a result of the Accelerated Sludge Removal Project (ASRP) initiative conducted during FY 1993 and 1994, wastes were removed from the Solar Evaporation Ponds and 788 Clarifier areas and placed into interim storage in double-containment storage tanks in Tents 3, 4 and 6 located on Pad 750. The objective of the current Greatly Accelerated Sludge Processing Project (GASP) initiative is to remove the solar pond sludge from the interim storage tanks and treat these wastes to satisfy the WAC for placement in the OU-4 closure area by blending them with contaminated soils and other appropriate additives.

Design and operational assumptions for the treatment process for the pond sludges are summarized in the following sections.

3.2.1 Characteristics of Pond Wastes

Ponds 207A, 207B-Series and 788 Clarifier

Based on the nature of their original source materials, the following assumptions are made regarding the sludges from Pond 207A, Pond 207B, and the 788 Clarifier:

- The interim storage tanks are filled with sludge and pond liquid to a depth of 9 to 10 feet. Each tank could contain approximately 9,000 to 10,000 gallons. As a basis for design, a volume of 10,000 gallons per tank has been assumed.

- The sludge, which consists of settled solids and a liquid phase, occupies approximately ninety percent of the tank volume. Some free water was decanted off of the settled sludges in the tanks during storage to reduce the volume in storage.

- The settled sludges, based on previous characterization studies (HNUS Deliverable 224A and 224E, March 1992), are expected to contain approximately 15 percent solids (by weight) and have a high viscosity (500-1000 centipoise).

- The free liquid phase which covers the settled sludge contains some dissolved salts (less than 16,000 mg/l), but has physical properties similar to water.

Pond 207C

The sludge from Pond 207C is different from that stored in the 207 A and B Ponds due to the nature and source of the original wastes deposited for evaporation. Previous sampling and analysis efforts have shown that the waste in the pond consisted of three general layers of material, as follows:

- A liquid phase which is a saturated or near-saturated brine, with sodium and potassium the predominant cations and nitrate, chloride, and sulfate the predominant anions. Significant concentrations of heavy metals were also present. The brine layer was stratified in Pond 207C, with lower Total Dissolved Solids (TDS) and specific gravity values near the pond surface, and higher TDS and specific gravity values at depth. The salinity of the brine layer was also a function of precipitation, evaporation, and temperature. The TDS of the brine layer ranged from 5.8 to 42.9 percent, by weight from 2.1 to 24.6 percent by weight, with an average of 12.1 percent. On a volumetric basis, the moisture content averaged 20.7 percent. Laboratory studies on these soils calculated an average saturated moisture content of 36.1 percent, indicating a capacity of the site soils to hold additional moisture. Of course, evaluation of soil moisture data must take into account the potential variability of moisture content due to daily weather conditions. Treatability studies will be conducted to develop an operating range of soil/waste moisture content which will enable the treated waste to meet the WAC.

Lime addition is planned to raise the soil pH to levels sufficient to kill pathogens and gas-producing micro-organisms associated with the pond sludges. An added benefit of lime addition is the additional absorption of moisture. If increased moisture reduction is required, quicklime (CaO) can be used instead of hydrated lime [$Ca(OH)_2$]. Quicklime chemically reacts with water to form hydrated lime. The amount of lime required for both pathogen/micro-organism destruction and for moisture control will be determined in the treatability study. The need for other additives will also be investigated.

3.2.3 Operating Parameters

The daily operating schedule for the sludge treatment facility is a function of:

- the total volume of sludge requiring treatment,
- the available time period for operating (i.e., maximum 10-month period),
- the requirements of the treatment mix formulation,
- the logistics of materials handling (e.g., soil and treated waste),
- delays or operating interruptions from outside sources.

Based on the parameters stated above and an assumed target moisture content of 20 percent in the treated waste, it is estimated that approximately 16,300 cubic yards of soil will be needed to mix with approximately 66,000 gallons of Solar Pond waste. It is also estimated that approximately 105 tons of lime will be used for control of pathogens and gas-producing micro-organisms, and that a yet-to-be-determined quantity of drying additive may have to be used for additional moisture control. These estimates are preliminary and are subject to revision based on the results of the treatability study to be conducted on the waste and soil. Table 1 summarizes a preliminary estimate of the volumes of waste, soil and lime required for the treatment/disposal of the Solar Pond sludge.

TABLE 1

VOLUMETRIC MATERIAL BALANCE
ACCELERATED SLUDGE PROCESSING CONCEPTUAL DESIGN

	C Pond	A/B Pond	Clarifier	Total
Waste Volume (CY)	2,045	1,089	134	3,268
Soil (CY)	11,922	3,925	483	16,330
Lime (CY)	75	39	5	119
Other Additions	TBD	TBD	TBD	TBD
*Total Product (CY)	14,042	5,053	622	19,717

TBD - To be determined during treatability study.

*The total product estimate is conservative because it does not account for the increase in soil density when the soil absorbs moisture from the waste. The treatability study will determine the actual volumetric increase of the treated product.

3.3 REGULATORY CONSIDERATIONS

3.3.1 Status of Units of Interest

The Rocky Flats Plant is undergoing a phased program of permitting under RCRA. The facility is applying for permitted status for various hazardous waste units in accordance with prioritization and a schedule negotiated with the CDPHE. Accordingly, Rocky Flats Plant operates under both interim and final (permitted) status. The Solar Evaporation Ponds 207A, 207B, and 207C and the 788 Clarifier form three interim status units (The 788 Clarifier and 207C Pond are each separate units; the 207A and B Ponds are combined to form one unit). Pad 750, upon which the tents that house the sludge storage tanks have been placed as well as the tent which will house the sludge treatment equipment, is also an interim status unit. Both units are to be closed under interim status.

3.3.2 Regulatory Compliance Strategy

To facilitate the timely processing and disposal of the pond sludges within OU-4, the remedial design proposes to take advantage of modifications to 40 CFR Parts 264 and 265 promulgated by the USEPA on February 16, 1993, and the Colorado analog in 6 CCR 1007-3 promulgated on May 31, 1994. These rules allow for the creation of Corrective Action Management Units (CAMUs) and Temporary Units (TUs). These units "function solely to manage wastes that are generated at a RCRA facility for the purpose of implementing remedial actions required at that facility"... (FR Vol. 58, No. 29, p. 8659). Among other provisions, the rulemaking allows remediation wastes to be consolidated or processed on site without triggering Land Disposal Restrictions (LDRs) or Minimum Technology Requirements (MTRs) which were promulgated to control hazardous waste production from ongoing manufacturing activities. The requirements for the application of CAMUs and TUs are presented in 40 CFR 264 Subpart S, which addresses RCRA-permitted facilities. These requirements are incorporated by reference in 40 CFR 265.1(b) which addresses interim status facilities and which applies to the closure of the Solar Ponds. Colorado's rules substantively incorporate the intent and scope of the Federal rules with certain modifications which address the harmonizing of the CAMU and TU requirements with Colorado's existing hazardous waste rules, and which clarify ambiguities in the Federal rules.

Therefore, the following design assumptions are made:

- Equipment used at the excavation site (i.e., earth moving equipment) is considered to be related to the closure of this unit. Such equipment will be the responsibility of the excavation contractor. This includes the mobile soil screening equipment to be used for the removal of oversize and foreign materials at the excavation area, and the associated materials handling and truck/container loading equipment that will be required as part of this design.

- The treatment equipment to be located in Tent 6 on Pad 750 will be a TU. (It is assumed that a CDPHE permit will be issued for this TU).

- The Solar Ponds will form a CAMU and will serve as the disposal site for the sludges which have been removed from the ponds and are in storage on Pad 750, as well as the disposal site for contaminated soils from an adjacent area located outside the boundaries proposed for the CAMU.

In general, hazardous waste treatment units require secondary containment, with exemptions applied to certain types of facilities. The TU rule does not specifically address secondary containment requirements, leaving the determination of the applicable standards to Colorado. It is possible that the treatment system would be entitled to the exemptions provided in the regulations, even if there was no latitude provided in the application of standards. However, for purposes of this design, the following assumptions are made:

- The processing equipment will be provided with secondary containment.

- The sludge feed tank will be emptied prior to weekends, holidays, or extended downtime, by processing sludge and soil until no sludge remains, or by returning leftover sludge to the interim storage tanks from which it was collected.

- Secondary containment provisions will not be applied to soil and treatment additive(s) since these materials are relatively immobile, and will be carefully contained. Similarly, secondary containment provisions will not be applied to the treated waste (blended soil and sludge) .

3.3.3 Other Compliance Requirements

Certain emissions and exposure restrictions apply to USDOE facilities which engage in the management of materials containing radionuclides. With respect to emissions, the National Emissions Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities apply (40 CFR 61.96). These standards specify standards for radionuclide levels in ambient air. In view of the low level of radioactivity associated with the sludges and soils, an emissions impact and/or a significant air permitting effort are not anticipated to be necessary for this design. This matter will be reviewed with the Rocky Flats Plant air quality specialists during the preparation of the CDR and air permitting or monitoring requirements will be specified accordingly.

Applicable occupational exposure limits are addressed in USDOE Order 5480.11. These limits consider the exposures that may occur from all pathways, and relate to worker protection.

USDOE Order 5400.5 requires USDOE facilities and their contractors to implement As Low As Reasonably Achievable (ALARA) controls to emissions and discharges containing radionuclides. ALARA is a discretionary level of control that goes beyond regulatory requirements. For the purposes of this design, ALARA is assumed to be control of dust emissions by covering and maintaining potential sources under negative pressure, and by applying High Efficiency Particulate Air (HEPA) Filters to all vents and exhausts from potential dust sources.

Since no liquid discharges are anticipated from the proposed treatment facility, no standards related to discharges will apply.

3.3.4 Regulatory Criteria

The following environmental regulatory criteria apply:

- TUs can operate for no more than one year. Therefore, the sludges and contaminated soils of interest must be completely processed within this period.

- Transfer of materials between the tents by conveyors, transfer lines, or by means other than vehicles will require the use of secondary containment.

- Closure of the interim storage tanks is not a requirement for this project.

3.3.5 Health and Safety Criteria

The following health and safety related criteria apply:

- A Health and Safety Plan (HASP), prepared in accordance with the ASRP Health and Safety Plan, will be required prior to any processing or placement of remediation wastes. The HASP will address medical monitoring requirements, industrial hygiene monitoring for heavy metals, and radiation dose monitoring.

- Operational guidance described in the HASP will be observed by the operators.

- Personal Protective Equipment will be worn by operators in accordance with the HASP.

- All operators will be provided with 40 hour hazardous materials training in accordance with 29 CFR 1910.120 prior to engaging in remediation activities.

- All operators will be provided with instruction in accordance with the Federal Hazard Communication Standard (29 CFR 1910.120) prior to engaging in remediation activities.

- All operators will undergo site-specific radiation worker training prior to engaging in remediation activities.

All operations will be conducted in accordance with the USDOE Radiation Control Manual and the Rocky Flats Plant radiation protection requirements. This White Paper assumes that all Health & Safety monitoring required by the HASP will be performed by EG&G Rocky Flats.

4.0 TREATMENT SYSTEM DESCRIPTION

The waste sludges from the Rocky Flats Solar Evaporation Ponds 207A, 207B, 207C and the 788 Clarifier are currently in interim storage in sixty-six 10,000-gallon, double-contained, high-density polyethylene tanks located in tents on the 750 Pad. These sludges will be: removed from the tanks; treated with lime to destroy any pathogens and gas-producing micro-organisms; and mixed with screened contaminated soil and/or other additives, if required, to produce a treated waste which satisfies the WAC for the "Contaminated Media" layer of the OU-4 Interim Remedial Action (IRA) closure area.

The WAC for the OU-4 closure area are described in detail in Section 3.1. The primary WAC which pertain to the treated waste are: (1) no free liquids [i.e., pass the Paint Filter Liquid Test (SW 9095) for "as-delivered material"] and (2) be compacted to 90% Proctor density. The sludges will be treated sufficiently to satisfy the above WAC upon placement into the OU-4 closure area.

The treated waste will be staged in closed containers on the 750 Pad while tests are conducted to confirm compliance with the WAC. Upon satisfying the WAC requirements, the treated waste will be transported to the OU-4 closure area on an as-needed basis for distribution and placement by the closure work area contractor.

The pond sludge treatment system, shown on Figure 1 and Drawing 1, will consist of the following unit operations:

- Sludge removal and transfer
- Contaminated soil screening and handling
- Treatment additives handling
- Treatment/blending of sludge, soil, and additive(s)
- Treated waste handling and testing
- Treated waste transfer to OU-4 closure area

The handling and treatment operations will utilize standard "off-the-shelf" equipment wherever possible. In addition, a number of the equipment modules (tanks, agitators, pumps, etc.) constructed earlier for the Pond A/B and Pond C Cement Stabilization systems will be used where applicable. Treatment equipment will be modified, as necessary, to conform to applicable Rocky Flats Plant Health & Safety and Environmental Standards.

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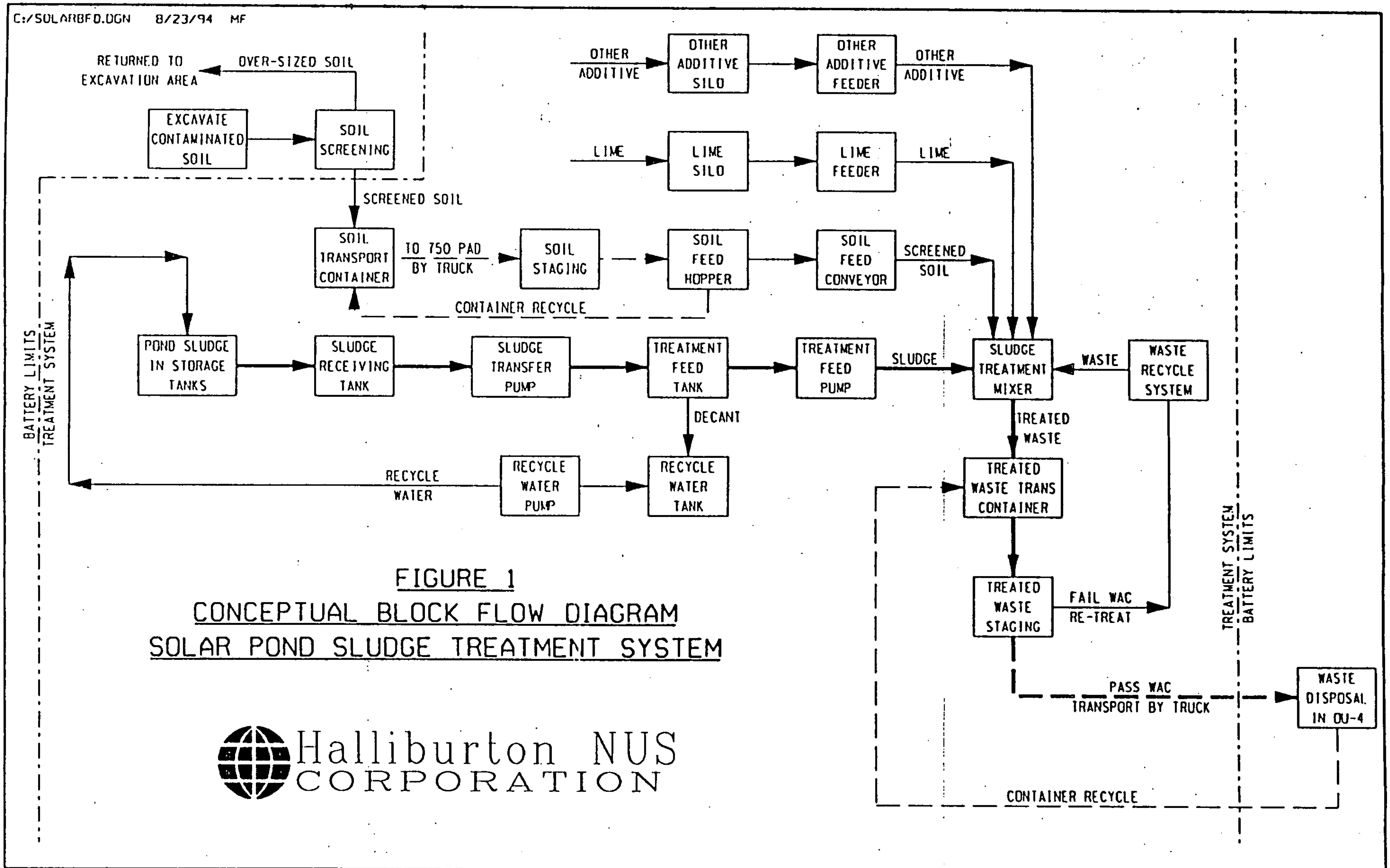

FIGURE 1
CONCEPTUAL BLOCK FLOW DIAGRAM
SOLAR POND SLUDGE TREATMENT SYSTEM

Halliburton NUS CORPORATION

Containers for the transport of the screened contaminated soil and treated waste will be covered to prevent air emissions and loss of material during transfer to the treatment system. Once the containers have been emptied, they will be returned to their respective unit operations for reuse.

4.1 SLUDGE REMOVAL AND TRANSFER

4.1.1 Operations Description

The sludges from the five Rocky Flats 207 Solar Evaporation Ponds and 788 Clarifier are currently in interim storage in 10,000-gallon capacity, secondarily contained polyethylene tanks located in tents on the 750 Pad. There are approximately 660,000 gallons of sludge in the 66 interim storage tanks.

There are several methods available for removing the sludges from the storage tanks (e.g., semi-portable vacuum system, vacuum truck, submersible slurry pumping, etc.). The sludge removal system described below is based on a semi-portable vacuum system because it offers the following advantages:

- It can be located closer to the storage tanks than a vacuum truck,
- It can be emptied and cleaned between batches more easily than a vacuum truck,
- It provides a greater suction head than a vacuum truck,
- It can remove the contents of the tanks more thoroughly than a submersible slurry pump.

The sludge removal system will be used to aspirate the sludges from the tanks to a receiving tank. The suction end of the vacuum hose will be introduced through the manways at the top of the tanks and extended into the sludge. The position of the hose end will be carefully controlled manually to prevent aspiration of air into the suction system. Any liquid which decants from the sludge will be collected and recycled, as necessary, to fluidize the sludge and to rinse the tanks. The sludge receiving tank will be fully enclosed and will include a venting system equipped with a HEPA filter to treat the pressurized air discharge from the vacuum system.

The sludge collected in the receiving tank will be transferred to the treatment system feed tank by a progressive-cavity discharge pump and slurry pipeline, which will be a high pressure rubber hose system with quick-disconnect fittings to facilitate installation and removal.

4.1.2 Operations Control

Removal of the sludges from the interim storage tanks will be a manually-controlled operation. Operational control of the semi-portable vacuum system (or a vacuum truck or submersible pump system) will be through a **START-STOP** engine switch and/or an **ON-OFF** electrical push-button. The volume of sludge removed will be measured by determining depth of liquid in the receiving and/or storage tank.

Transfer of the sludges from the receiving tank to the treatment system feed will also be a manually-controlled operation. Operational control of the receiving tank discharge pump will be through an **ON-OFF** electrical push-button. The flow of sludge transferred to the treatment system will be measured and indicated by a flow metering device and controlled by manually adjusting the variable speed drive of the discharge pump.

Grab samples of the removed sludge will be collected at the rate of one sample per interim storage tank. These samples will be field-analyzed for percent moisture content. Results of these field analyses will be used to adjust the feed rate of sludge, and/or the feed rates of soil and additives(s), to the treatment system.

4.2 SOIL SCREENING AND HANDLING

4.2.1 Operations Description

The primary additive used in the treatment of the sludges to prepare them for placement in the OU-4 closure area is screened contaminated soil. Preliminary estimates show that to achieve a target moisture content of 20 percent (by weight) in the treated waste (to be determined by treatability testing), approximately 5 to 6 tons of contaminated soil (based on a moisture content of about 12 percent, by weight) will be required for every ton of sludge feed. This contaminated soil will be screened by the excavation contractor to remove all oversized materials in order to protect treatment mixing equipment and to fall within the 3-inch or less limit specified by the WAC. Oversized and foreign materials (trash, plants, etc.) will be removed. Selection of the screening size (likely to be 2-inch or less) is an important variable in controlling the compaction characteristics of the treated waste. The soil screening and handling system will be made up of standard equipment used in aggregate product screening and handling operations. Since the amount of soil required in the treatment mixture depends primarily on the quantity of moisture initially in the soil and on the permissible target moisture limitation in the treated waste, the quantity of soil required will vary in proportion of these moisture contents.

Screening and handling operations will occur in the following sequence:

- The excavation contractor will load as-excavated soils from the reclaim area into a loading hopper.

- The hopper will be equipped with an inclined grizzly bar screen (bars set approximately 4 inches apart), which will remove gross oversize rocks and trash material.

- The loading hopper will feed the material pre-screened by the grizzly bars (i.e., smaller than 4 inches) to a dry screen of a size consistent with the requirements of the treatment mixer/blender and the treated waste compaction characteristics (e.g., probably 2 inches or less).

- The screened soil will be conveyed and loaded into containers for transport to the treatment facility located on the 750 Pad.

The soil screening and handling equipment will be located at or adjacent to the active soil excavation area. The soil will be screened by the excavation contractor, but the handling and transport of the soil will be performed by the treatment contractor.

The standard aggregate screening and handling equipment will be modified as necessary to eliminate the potential for any dust emissions by the enclosure of critical components and application of negative pressure. The enclosed systems will be vented through a dust collection system driven by an exhaust-side blower system. A HEPA filter will be installed on the dust collection system vent. Dust emissions from the hopper loading and grizzly bars pre-screening operations will be controlled by the excavation contractor, as required, by using water sprays. Use of water, however, will be controlled to minimize the moisture content of the screened soil. The materials removed by the grizzly bars and screen will be handled and disposed of by the excavation contractor.

The screened soil will be loaded into transport containers, equipped with a "live-bottom" unloading system which will allow discharge of the screened soil from the end of the container without the need for tilting, dumping or lifting. The live-bottom mechanism can be a "walking-floor", where movable floor plates articulate to move the load material to the discharge end, or other type of mechanism such as a floor belt conveyor or screw feeder. These type of live-bottom containers are commonly used for delivery of asphalt/aggregate road base materials, rock salt, etc.

The screened soil will be loaded into live-bottom transport containers using a conveyor equipped with a shrouded chute to minimize dust emissions during loading. The containers will be sealed with a tarp cover after loading to minimize dust emissions and loss of contaminated soil during transport and staging of the screened soil. The horizontal discharge capability of the live-bottom containers will allow the screened soil to be discharged directly into the sludge treatment system soil feed hopper with a minimum of dust generation. While mated with the treatment system feed hopper, the container will also be under negative pressure to control any emission of dust during unloading.

Several (eight or more) live-bottom containers will be used for staging purposes to provide a ready supply of screened soil for at least one day of operation of the treatment system.

4.2.2 Operations Control

Screening of the contaminated soil used for sludge treatment will be a manually-controlled operation. Operational control of the screening equipment will be through a **START-STOP** engine switch. The soil screening rate will be dictated by the size of the screening equipment and by the rate at which the contaminated soil is loaded into that equipment.

Transportation of the screened soil from the excavation area to the soil staging area and from the soil staging area to the treatment system will be controlled by regulating the number and frequency of container movement.

Grab samples of the screened soil will be collected from the staging area. The soil samples will be field-analyzed for moisture content and Proctor density. Results of these field-analyses will be used to adjust, as required, the feed rate of soil, and/or the feed rates of sludge and additive(s), to the treatment system.

4.3 TREATMENT ADDITIVE HANDLING

4.3.1 Operations Description

Besides the screened soil, other additive(s) will be used in the treatment process. Although treatability study testing will be required to confirm the nature and quantity of additives to be used, it is likely that lime (hydrated or unhydrated) will be added in quantities sufficient to achieve a pH of approximately 12 in the treated waste to destroy any pathogens and gas-producing micro-organisms that may be present in the sludge. Lime will also control the final moisture content of the treated waste. For the purpose of this White Paper, it is assumed that hydrated lime [$Ca(OH)_2$] will be used, at the rate of 500 pounds of lime will be added per dry ton of solids for the Pond 207A and Pond 207B sludge, and at the rate of 50 pounds of lime will be added per wet ton of Pond 207C sludge.

Other additives such as pozzolanic agents (Portland cement, fly ash, etc.), soil agglomeration agents (e.g., bentonite) and/or drying agents (e.g., calcium chloride, silica gel, etc.) may also be required, pending the results of treatability testing.

For purposes of this White Paper, it is assumed that lime and a drying agent (in addition to the soil) will be required. Therefore, two reagent storage and feeding systems will be provided for the treatment system.

The treatment additives will be delivered to the treatment site by bulk hopper truck and stored in silos. They will be transferred from the hopper truck to the storage silos by a standard commercial pneumatic transport and delivery system which is part of the bulk hopper truck unloading system. The storage silos will be equipped with a passive venting and dust collection system which will control any emissions during delivery or operations.

The additives will be fed to the treatment mixer/blender by feeder systems (belt or screw feeder) which will be calibrated to provide positive control of the additive feed rate. The additive feed systems will be totally enclosed (either as an enclosed belt or auger-screw feeder) and will discharge directly into the treatment system mixer/blender. Negative pressure in the mixer system will control any potential additive emissions.

4.3.2 Operations Control

Transfer of the treatment additives from the delivery vehicle to the storage silos will be a manually-controlled operation. Operational control of the transfer air blower will be through an ON-OFF electrical push-button.

The amount of additive in the storage silo will be measured and indicated by level-sensing devices. High- and low-level conditions inside the storage silos will be alarmed.

The transfer of additives from the storage silos to the treatment system will be a manually-initiated and semi-automatically-controlled operation. The additive feeder devices will be manually started and stopped by **ON-OFF** electrical push-buttons and the additive feeds will be automatically controlled to a manually-set rate by weight-sensing devices which will regulate the operational speed of the additive feeders.

4.4 TREATMENT MIXING/BLENDING

4.4.1 Operations Description

The treatment process consists of mixing/blending the sludges with screened contaminated soil, lime and other additive(s), as necessary, to produce a treated waste that satisfies the WAC. Standard mixing/blending equipment, modified for this application, will be used for this process.

The treatment system will consist of a single train including the following materials handling and mixing components:

- An auxiliary skid-mounted module consisting of sludge feed tank, mixer, and pump. The sludge feed tank is cone-bottomed with sludge decanting capability. The sludge feed pump is a variable speed progressive-cavity, positive-displacement type.

- A process water tank mounted on the main skid. This tank is filled with recycled liquid decanted from the sludge feed tank (or with fresh water make-up, if required). Process water is recycled back to the sludge removal operation by a centrifugal pump and flexible hoses for sludge dilution and/or tank rinsing.

- A soil loading and feed hopper mounted on the main skid. This hopper will receive soil discharged from the end of the live-bottom containers.

- A variable-speed conveyor belt mounted on the main skid. This conveyor discharges the soil from the feed hopper into the treatment mixer/blender. The conveyor is equipped with a belt scale to monitor the soil feed rate.

- A feed port mounted on the main skid for additive(s) discharge to the mixer/blender.

- A high-torque pug-mill-type mixer/blender mounted on the main skid.

The treatment mixing/blending process is one of homogenization, as opposed to the high-intensity mixing requirements of a chemical or cement stabilization process. The lime (and other additives) serves as a binding agent for the finer soil and sludge particles, and as an absorbent for excess water, in addition to serving as a biocide. The character of the treated waste is presumed to be similar to damp soil. It will have no free moisture (estimated maximum moisture content of 25 percent by weight) and should be dust free (estimated minimum moisture content of 15 percent by weight).

4.4.2 Operations Control

The treatment of the sludges by mixing/blending with screened contaminated soil and additive(s) is a manually-controlled operation. Operational control of the blending equipment will be through an **ON-OFF** electrical switch. The rate of production of treated waste will be controlled by the size of the blending equipment and the feed rates of the sludges, screened soil, and additive(s), which will be based on sludge and soil moisture contents and operating parameters developed from the treatability test results.

4.5 TREATED WASTE HANDLING

4.5.1 Operations Description

The treated waste is discharged from the treatment system conveyor directly into transport unit containers (e.g., 22-cubic yard roll-off boxes). When filled, a container will be covered with a tarp and moved away from the loading point to permit introduction of an empty container. The containers of treated waste will be staged on the 750 Pad, or at another suitable area, to provide a period of time to complete the testing of the treated waste samples (see Section 4.5.2). Staging of treated waste will also provide a surge or buffer capacity between the operating requirements and schedule of the treatment system and those of the closure area contractor. Several containers (probably 8 or more) of treated waste will be staged representing one or two days production of the treatment system.

Routine testing of the staged treated waste will be performed as discussed in Section 4.5.2. In the unlikely event that a treated waste container does not satisfy the WAC, retreatment will be required. Nonattainment of the WAC may result from changes in the waste or soil characteristics. Typically, it is expected that the treatment mix formulation will be effective over a wide range of operating conditions and soil/sludge compositions.

In the event that a container of treated waste fails to meet the WAC, the off-specification material will be removed from the container and returned to the blender/mixer of the treatment system by a portable vacuum system similar to that used for removal of the sludges from the interim storage tank (see Section 4.1). In the blender/mixer the off-specification treated waste will be mixed with extra soil and/or additive(s) to meet the WAC.

4.5.2 Operations Control

The transfer of the treated waste from the treatment system blending equipment to the treated waste staging area will be a manually-controlled operation. Operational control of the treated waste conveying equipment will be through an **ON-OFF** electrical push-button.

Grab samples of the treated waste will be collected at the staging area at a rate determined statistically based on data generated during the treatability study. These samples will be field-tested for compliance with the WAC. In particular, these field tests will verify that the treated waste samples pass the paint filter test and can be compacted to 90 percent of Proctor density under conditions representative of placement in the closure area. The treated waste samples will also be field-analyzed to verify that the pH of the treated waste is at least equal to the value determined from the treatability study as necessary for the destruction of pathogens and gas-producing micro-organisms.

4.6 TREATED WASTE TRANSFER TO OU-4

4.6.1 Operations Description

The treated waste will be transferred to the OU-4 closure area in the same containers as used for staging. Once the treated waste has been removed from the containers at the OU-4 closure area, the empty containers will be returned to the treatment area to receive additional treated waste.

4.6.2 Operations Control

Transportation of the treated waste from the staging area to the placement area will be controlled by regulating the number and frequency of the containers.

4.7 DECONTAMINATION AND DECOMMISSIONING

4.7.1 Description

Upon completion of solar pond sludge treatment activities, the removal and treatment equipment will be decontaminated and decommissioned.

Decontamination will consist of blowing-off with compressed air and thoroughly flushing and rinsing with fresh service water all vacuum units, pumps, mixers, tanks, hoppers, containers, and piping which came into contact with the solar pond sludge, the contaminated soil, the treatment additive(s), and the treated waste to completely remove these materials from the equipment. As required, the decontamination process may also involve the use of low-pressure steam or mechanical scrubbing with detergent-type products or other solvents. Waste decontamination fluids will be transferred to the Building 374 Spray Dryer for disposal.

Decommissioning will consist of dismantling the sludge removal and treatment system to the extent that it will not be possible to re-activate this system on an instantaneous, or near-instantaneous basis. To this effect, flexible piping and hoses will be removed, hard-piped connections will be broken, blind flanges will be installed, and operating valves will be removed. Electrical supply to control panels and switches will be disconnected and strategic wiring removed. Additive storage silos will be emptied and the additives stockpiled at a remote location or used elsewhere in the Rocky Flats Plant.

4.7.2 Process and Operational Controls

The decontamination and decommissioning of the sludge removal and treatment system will be a strictly manual operation.

The effectiveness of the decontamination process will be verified by the collection and analysis of wipe samples from the decontaminated equipment to verify that all waste and additives have been adequately removed.

5.0 SCHEDULE

Based on the information generated in this White Paper and the schedule for the placement of the treated waste that was presented to HNUS by EG&G Rocky Flats on August 10 and 11, 1994, the following estimated project schedule for the Solar Pond Sludge Treatment System Project was developed:

• Complete Conceptual Design Report	December 1, 1994
• Begin Title II Design	February 1, 1995
• Complete Title II Design	June 30, 1995
• Begin Procurement/Installation	August 1, 1995
• Complete Procurement/Installation	December 29, 1995
• Begin Commissioning/Training	January 2, 1996
• Complete Commissioning/Training	January 31, 1996
• Begin Treatment Operations	February 1, 1996
• Complete Treatment Operations	August 9, 1996
• Begin Decontamination and Dismantling	August 12, 1996
• Complete Decontamination and Dismantling	September 6, 1996
• Schedule Reserve	September 9 to November 29, 1996

The treatment operations schedule is based on processing approximately 5,000 gallons of pond sludge per average operating day, which generates a treated waste volume of approximately 150 cubic yards per average operating day.

This schedule assumes that the review periods that occur between the various project activities will proceed in a timely manner.

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6.0 COST ESTIMATES

The following preliminary cost estimates are based on the solar pond sludge treatment system described in this White Paper:

Procurement and Installation (Capital Cost)	\$3,000,000
Operations and Maintenance Costs	\$2,900,000
Decontamination and Dismantling Costs	\$ 110,000

The operations and maintenance costs are based on operating 16 hours/day, 5 days/week for 10 months.

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ROCKY FLATS
SOLAR POND PROJECTS

ACCELERATED SLUDGE PROCESSING CONCEPTUAL DESIGN

WHITE PAPER

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August 24, 1994

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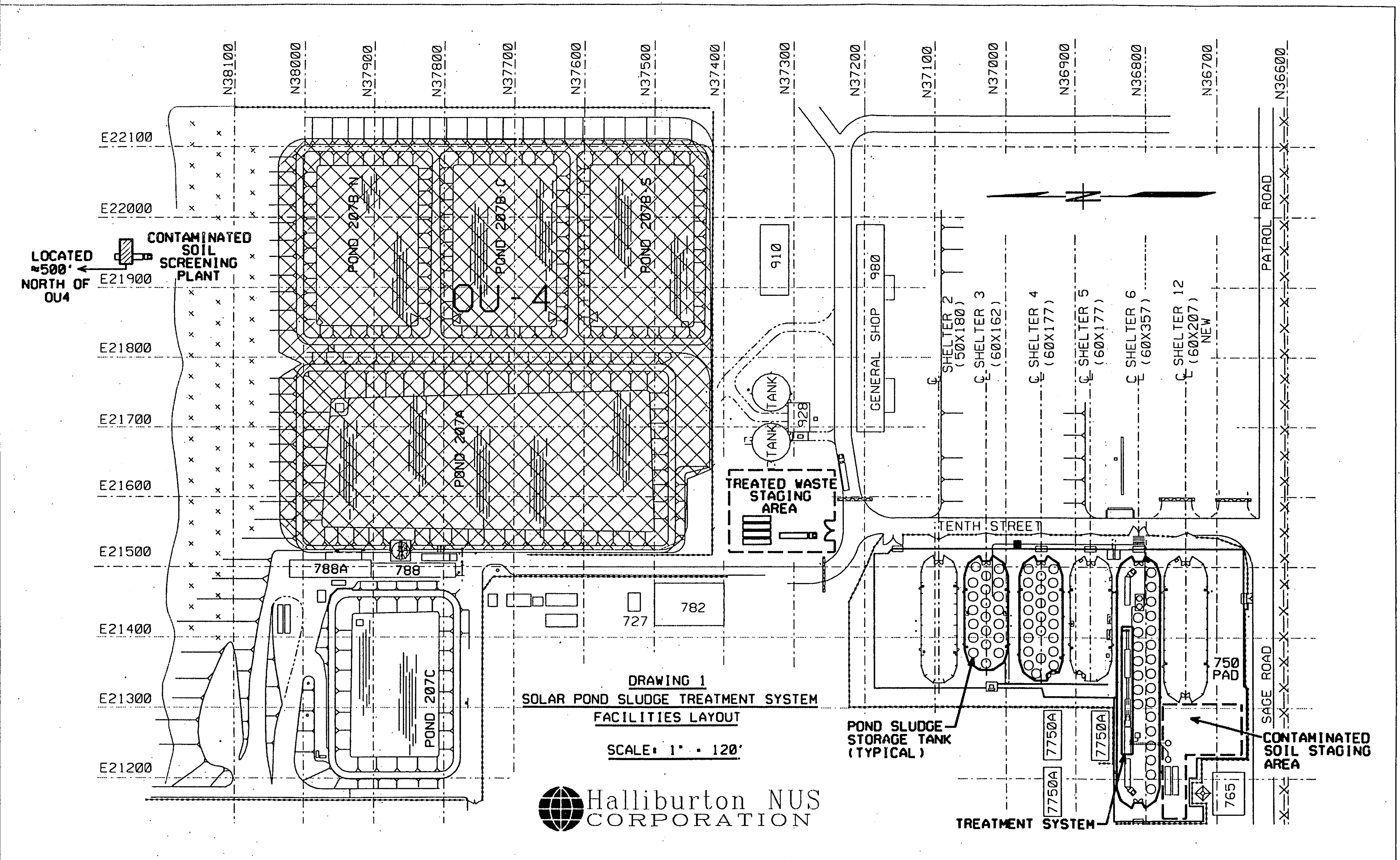

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